

**The University of the Witwatersrand**

**ELEN 1002 – Concepts of Design**

**BSc Applied Computing**

**Project 1:**

**Hoverboard Design**

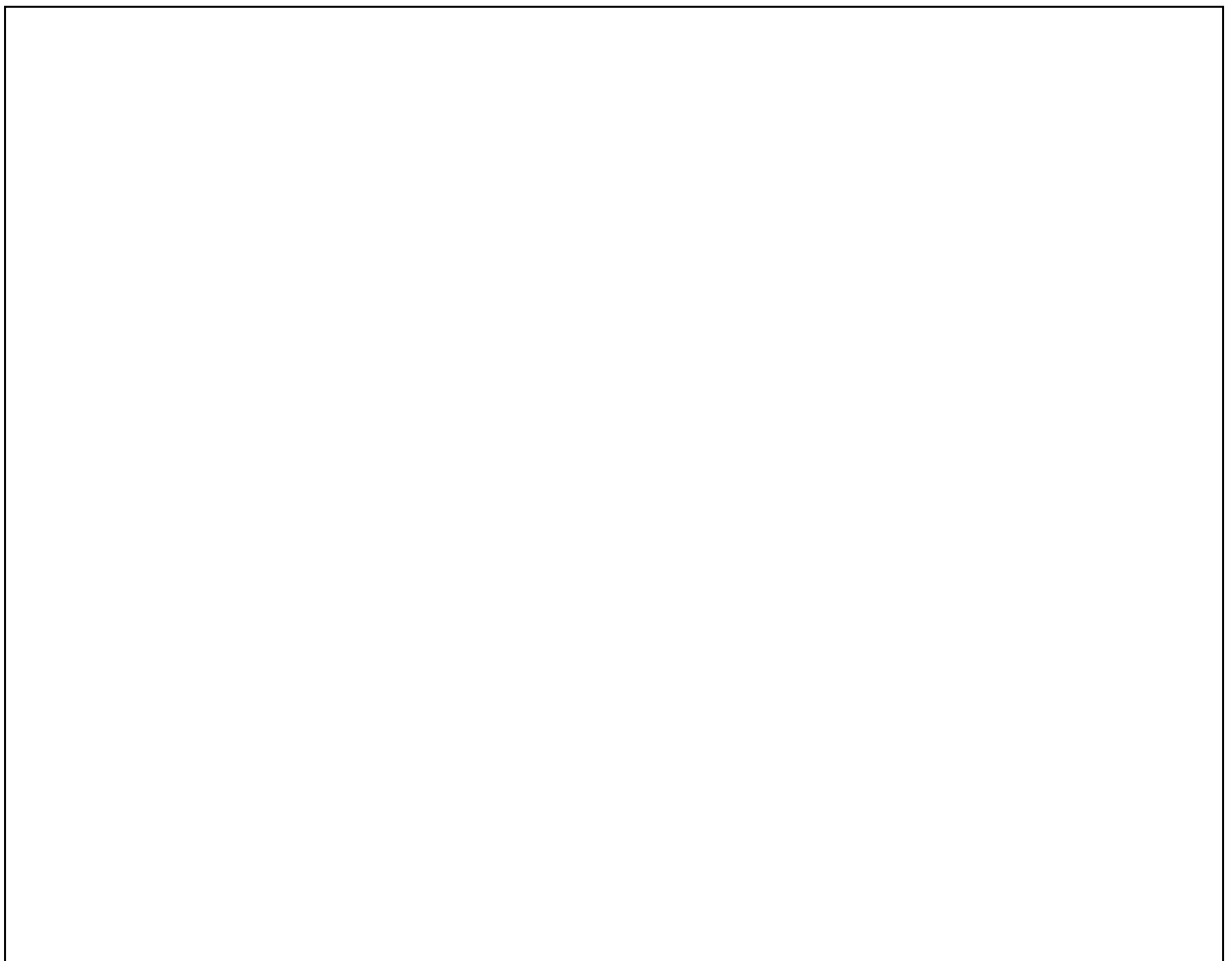
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**Abstract**

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# 1. Introduction

The project which was tasked was to design a viable Hoverboard which is able to hover above the ground as well as carry an 80kg person and travel at a top speed of 30km/h. The design must incorporate currently available and existing technologies and ideas from a range of fields including electronics, computational devices and aeronautics to create a solution which is plausible.

## 1.1. Aim and Hypothesis

The aim is to prove that it is viable with current technology to design and build a functional and useable Hoverboard.

## 2. Background

The idea of a Hoverboard was first proposed in the series of science fiction films called 'Back to the Future'. It was shown as an idea of where futuristic technology would be able to be used to create something which, at the time when these movies were created, was impossible to fathom outside the realm of fiction due to the many restrictions which the then current technology had. These restrictions prevented the technology of the day being small enough, computationally powerful enough and energy efficient enough to be viable.

The ability to create a device which hovers above the ground is very possible in the realm of physics and has even been done on a fairly large scale. (See 2.1 Current Solutions.)

### 2.1. Current Solutions

There are several different approaches to creating a device which has the ability to hover above the ground. A generalised term for these devices would be, 'hovercraft'.<sup>[1]</sup>

There are more boat like vehicles which can be very small from one passenger carrying device to very large devices which carry many passengers. These boat systems tend to use air pressure to create an air pocket underneath the craft which it then floats on. The rotors used to create the air pressure tend to be very loud and unpleasant for someone who would like a comfortable and smooth ride within the vehicle. The rotors are usually fuel driven and are quite large in size for the air pressure which they are able to build up. The electrically driven ones also use a large amount of energy and are therefore not too efficient. These devices also tend to be quite heavy and large for the load which they carry.

There are also more aircraft like devices which also have the ability to hover and vertically take-off, more specifically certain models of fighter jets such as the Harrier VTOL<sup>[2]</sup>. This aircraft is able to perform vertical manoeuvres while still having the capability of moving in a more conventional manner. The aircraft uses jet thrusters which are able to move and swivel allowing the thrust to be directed in such a way as to allow for both vertical and horizontal control of the aircraft.

## **2.2. Equipment**

The equipment used in the lab to assess the design will mainly be devices such as GPS location and infrared speed trapping devices to assess the speeds on the prototype in the real world once it is built<sup>[3]</sup>. There are also cameras to document the experiments done with the prototype. A Selective laser sintering machine is also used to create the prototype since the use of light, strong and durable plastics which can be moulded straight from CAD data is desirable<sup>[4]</sup>. Thermometers will be used to measure the heat output produced by the prototype and assess the risk factors involved with the device. Weights will be used to test the prototype without the use of a person in early trials.

## **2.3. Constraints and Assumptions**

The constraints provided are that the device must be able to hover, hold an 80kg person, travel up to a speed of 30km/h and have certain safety considerations. It has been assumed the force due to gravity  $g = 9.8 \text{ m.s}^{-1}$  and that the centre of gravity is in the middle of the board so that it is balanced. There is also an unlimited budget for this project.

## **2.4. Mathematical Calculations**

### **3. Design 1**

This design has taken into account many considerations such as aerodynamics, upward lift and directional thrust. The design still conforms to the idea of a Hoverboard. (See Appendix A. for the technical drawings.)

#### **3.1. Thrust Considerations**

Calculations in Appendix A

#### **3.2. Physical Dimensions**

Calculations in Appendix A

#### **3.3. Control**

#### **3.4. Weight**

Calculations in Appendix A

#### **3.5. Material**

#### **3.6. Safety**

#### **3.7. Mathematical and Physics Calculations**

See Appendix A. That is where I will most likely be placed.

#### **3.8. Estimated Cost**

Calculations in Appendix A

## **4. Analysis of Design**

### **4.1. Results**

### **4.2. Analysis of Results**

### **4.3. Possible Improvements**

## **5. Conclusion**

## **Acknowledgements**

## **References**

Anguah, K and Szapiro, N, 'Design and Construction of a Passenger Hovercraft', Swarthmore College, 2009

DiscoverHover, 'Why a Hover Craft Hovers: Pressure and Lift', <http://www.discoverhover.org/infoinstructors/guide4.htm/>, 2004, World Hovercraft Organisation, Accessed: 2013-03-07

Green, W. E. and Y. Oh, P, 'A MAV That Flies Like an Airplane and Hovers Like a Helicopter.', Drexel University, Philadelphia, Accessed: 2013-03-10

## Appendix A: Design 1

Hoverboard test:	Thrust (N)	Acceleration ( $\text{m.s}^{-2}$ )	Mass (kg)	Height (m) in 5 sec acceleration	Power(W) in 5 seconds
1	980	0	100	0	0
2	1180	2	100	2	11800
3	1380	4	100	4	27600
4	1580	6	100	6	47400
5	1780	8	100	8	71200
6	1980	10	100	10	99000

**Table to show Hoverboard in vertical hover for 5 seconds while changing the board's acceleration.**

$f=ma=T$

Assume mass of hoverboard and person 100kg for now

